

ratus to separate a demodulation reference signal DMRS of a first user terminal and a sounding reference signal SRS of a second user terminal, transmitted on a same time domain resource, by a code division multiple access methodology.

**[0065]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply an orthogonal cover code over the reference signal sequences, wherein an increased amount of demodulation reference signal DMRS and sounding reference signal SRS resources is obtained.

**[0066]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply uplink channel sounding based on a combination of SRS and DMRS, wherein one or more reference signal RS symbols are used for the combination of SRS and DMRS.

**[0067]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply uplink channel sounding based on an SRS symbol and a combination of SRS and DMRS.

**[0068]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply uplink channel sounding and SRS based on a single symbol combination of SRS and DMRS.

**[0069]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to determine the power offset by separate power controlling applied separately for DMRS and SRS.

**[0070]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to drop the reference signal sequence part used for the channel sounding, if the power of a combined DMRS SRS symbol exceeds a maximum transmission power.

**[0071]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to, if the power of a combined DMRS SRS symbol exceeds a maximum transmission power, autonomously reduce the transmission power used for the reference signal sequence part used for the channel sounding, wherein transmission power reduction is defined by means of a relationship between a total configured maximum output power of the user terminal and an instantaneous transmission power of DMRS and SRS parts according to a following equation:

$$\hat{P}_{SRS}(i) \leq (\hat{P}_{CMAX} - \hat{P}_{DMRS}(i))$$

where  $i$  is a symbol index,  $\hat{P}_{CMAX}$  is a linear value of the total configured maximum output power of the user terminal (302),  $\hat{P}_{DMRS}$  is the linear value of a DMRS part, and  $\hat{P}_{SRS}$  is the linear value of an SRS part, respectively.

**[0072]** According to yet another exemplary embodiment, there is provided an apparatus comprising at least one processor; and at least one memory including a computer program code configured to, with the at least one processor, cause the apparatus to receive, from a user terminal (302), a demodulation reference signal DMRS and a sounding reference signal SRS in a same time domain resource, wherein a single reference signal sequence is used both for demodulation and detection of a data channel, and for channel sound-

ing, such that a reference signal sequence part used for the demodulation and detection of the data channel is in a power offset compared to a reference signal sequence part used for the channel sounding.

**[0073]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to provide code division multiplexing parameters defined for multiplexing between the demodulation reference signal DMRS and the sounding reference signal SRS, wherein a demodulation reference signal DMRS of a first user terminal and a sounding reference signal SRS of a second user terminal, transmitted on a same time domain resource, are separated by a code division multiple access methodology.

**[0074]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply an orthogonal cover code over the reference signal sequences, wherein an increased amount of demodulation reference signal DMRS and sounding reference signal SRS resources is obtained.

**[0075]** According to yet another exemplary embodiment, the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to allocate orthogonal resources to adjacent cells and/or collaborated multipoint COMP clusters in order to alleviate inter-cell interference.

**[0076]** According to yet another exemplary embodiment, a computer program product comprises program code means adapted to perform any one of the method steps when the program is run on a computer.

**[0077]** It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

#### LIST OF ABBREVIATIONS

**[0078]** 3GPP 3rd generation partnership project

AMC adaptive modulation and coding

BW bandwidth

CDM code division multiplexing

CM cubic metric

COMP collaborated multipoint

CS cyclic shift

DL downlink

DMRS demodulation reference signal

FDPS frequency domain packet scheduler

LTE long term evolution

LTE-A LTE-advanced

**[0079]** MIMO multiple-input multiple-output

MU-MIMO multi-user MIMO

OC orthogonal cover

PAPR peak-to-average power ratio

PDCCH physical downlink control channel

PMI pre-coding matrix indicator

PRB physical resource block

PUCCH physical uplink control channel

PUSCH physical uplink shared channel

RAN radio access network

RRC radio resource control

RS reference signal